DOCUMENT RESUME

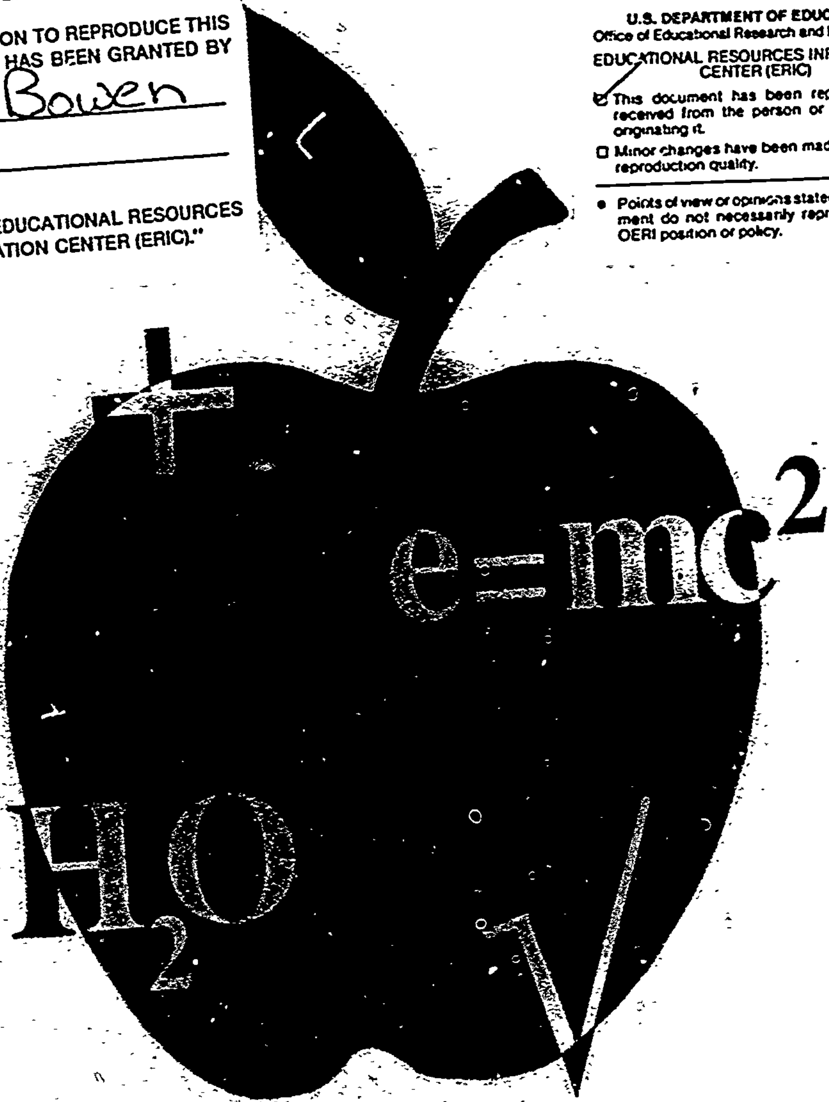
ED 325 379 SE 051 715

TITLE	School Boards & Curriculum. Special Focus on Science and Mathematics.
INSTITUTION	New York State School Boards Association, Albany.
PUB DATE	90
NOTE	46p.
PUB TYPE	Viewpoints (120)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	Academic Achievement; *Boards of Education; *Curriculum Development; *Educational Trends; Elementary Secondary Education; *Mathematics Curriculum; Mathematics Education; Needs Assessment; *Policy Formation; *Science Curriculum; Science Education; State Departments of Education; Teacher Education

ABSTRACT

Curriculum touches all members of a school's community. It is not surprising that something of great importance is influenced by many groups. At this crutial time, school boards should define their role in curriculum and encourage positive change based on sound decisions regarding what knowledge, skills, competencies, attitudes, and values students will need in order to become responsible citizens, productive workers, and effective parents in the world. This paper is divided into several sections. The introductory section addresses such basic problems as defining curriculum and establishing its priorities. The next section deals with the roles of the school board and others at the local level, as well as the role of the State Education Department. Science and mathematics are used as the context for the discussion of several issues. In the final section, teacher preparedness is addressed. The question of national curriculum standards is raised, as are issues related to the achievement of female and minority students in the sciences. The appendix contains policy samples, and the glossary defines terms used throughout this paper. (CW)

Special Focus on Science and Mathematics



A Position Paper of the
New York State School Boards Association

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Printed in the U.S.A.
3M/CLG 5/90

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Summary of Recommendations

1. School boards should set the tone and direction for the district's curriculum by developing a curricular philosophy, policy and goals. Curriculum should be a regular agenda item, discussed often and in depth.
2. Administrative personnel should be hired and evaluated based upon their ability and willingness to provide leadership in curriculum planning, development, implementation and staff development.
3. School boards should establish a framework of expectations to lead to opportunities for the involvement of constituencies who hold an interest in curriculum—teachers, parents, students, community members, and representatives of business and higher education.
4. Teachers should be highly involved in all phases of curriculum development. Continuing staff development should be provided to support their involvement.
5. The State Education Department should lead a broadly participative analysis of critical issues in curriculum. The State Education Department should also allow more flexibility to local districts that wish to adopt creative approaches to curriculum. Regulatory constraints should be removed if student performance is satisfactory.
6. Local districts, guided by their school boards, are strongly urged to exercise local curriculum-development opportunities. Consultation with state syllabi and handbooks is a necessary step in this process.
7. Curriculum should be designed to meet the dual challenge of providing all students with scientific and mathematical literacy and preparing students to go on to future studies and careers in the sciences. To this end, all students should be provided with strong foundations in science and mathematics and encouraged to continue study in these areas.
8. Science and mathematics education may need to shift emphasis in some areas if students are to be adequately prepared for life in the 21st century. Promising alternative curriculum frameworks should be considered, but regardless of the framework selected, the scope and sequence of content should be well designed to provide for coverage of key topics as well as opportunities for students to study topics in depth.
9. The environment of science and mathematics education should be appealing, vibrant and dynamic. Hands-on and computer-based

instruction should be among the variety of approaches used in science and mathematics education. The use of these methods should be integrated into the curriculum at all levels.

10. School boards should examine indicators regarding the access, participation and achievement of subgroups of students, such as females and minorities, in science and mathematics. If discrepancies exist, they should be redressed.

Introduction

Curriculum touches all members of a school's community—students, parents, teachers, administrators, and school board members. Many view it as the first and most important reason for having schools. Its end product—a well-educated citizenry—is the school's primary contribution to society.

It is not surprising that something of such great importance is influenced by many groups, including school board members, administrators, teachers, textbook publishers, developers of standardized tests, and lobbyists.

The roles of these and other players in curriculum have grown unclear and changeable. When the first school boards were established, they managed everything, including the curriculum. Much has changed since those early days.

The education reforms of the 1980s have emphasized the roles of educators, and more recently, what and how they teach children. As the 1990s begin, curriculum clearly holds the attention of educators, reformers, and others who represent a variety of interests.

At this crucial time, school boards should define their role in curriculum and encourage positive change based on sound decisions regarding what knowledge, skills, competencies, attitudes, and values students will need in order to become responsible citizens, productive workers and effective parents in tomorrow's world.

This paper is divided into several sections. The introductory section addresses such basic problems as defining curriculum and establishing its priorities. The next section deals with the roles of the school board and others at the local level, as well as the role of the State Education Department.

Science and mathematics education are used as a context for the discussion of several issues. The decision to select these subject areas was based upon several considerations. As a national economic and security concern, the performance of our students in science and mathematics has gained increased attention. Calls for a drastic overhaul of what is taught and how it is taught have multiplied, but policy-makers disagree on how this should best be accomplished. Lacking is a clear picture of what is actually being delivered and learned in classrooms and an understanding of the complexity of the many processes involved.

In the final section, teacher preparedness, an issue closely tied to the effectiveness of the curriculum, is addressed. The question of the creation of national curriculum standards is raised, as are issues related to the achievement of female and minority students in the sciences.

The appendix contains policy samples, and the glossary defines terms used throughout this paper.

What Is Curriculum?

Several issues are basic to any discussion of curriculum. Foremost is the definition of the word.

Think of curriculum as what is formally taught, the actual experiences that are planned and provided to students. Supporters of this definition recognize that the effectiveness of the curriculum depends largely upon the level of congruence between the *desired* curriculum as presented in syllabi and guides, the *actual* curriculum or the content of what is taught, and the testing program (see the Association position paper *Gauging Student Performance*).

Curriculum encompasses lessons and activities that take place in the classroom, resource room, laboratory, library and gym, on field trips and outings, assembly programs, group projects and performances, and planned social experiences.

The definition of curriculum as what is formally taught implies that it is something that can be managed and improved through planned intervention.[1]

But focusing on a child's formal learning experiences should not imply that the connection to informal, unplanned experiences should be ignored. Certainly, failure to consider the impact of all the events in a child's day on his or her educational experience will lead to an undermining of the curriculum, no matter how well-planned and structured it is, because the curriculum will not be integrated with the unique environment and culture of each school.

To illustrate this point, imagine a school where the children are formally taught the importance to the community of recycling paper, aluminum, and plastic, but where, because no arrangement is made to do otherwise, students regularly toss out these materials with the school trash. This type of incongruence surely works against the success of the curricular goal.

Curriculum: Content and Process

Those involved in curriculum review should consider what is meant by the term *educated person*. What are the essential facts and concepts that must be taught? In other words, what do students need to know?

Content is a crucial element in curriculum. Ideally, content provides students with the knowledge and ideas to construct new understandings. Thus, written goals and objectives for each level of schooling frequently build upon assumptions of prior learning.

Several subject-area groups have recognized the importance of content to educational reform and are providing guidance in this area. For example, a 1989 report of the American Association for the Advancement of Science provides educators with recommendations that constitute a common core of learning in the areas of science, mathematics and technology for students in kindergarten through grade 12. Another group, the National Council of Teachers of Mathematics, has offered specific content-area recommendations. The new focus on content, reflected in reports such as these, is part of the fallout from recent national and international assessments that have triggered alarm about Americans' scientific and mathematical illiteracy.

Historically, questions regarding how to best select and manage content have fueled debate among educators. These tasks, already laden with complex implications, are likely to become even more difficult. Trend watchers have noted that we live in a world in which the amount of knowledge is increasing geometrically. Knowledge and skills become obsolete rapidly. Futurists predict a profound impact on education.[2]

The success of teaching everything of importance grows elusive. There is a real danger that attempts to do so will reduce essential knowledge to trivial verbalisms or lists.[3]

Curriculum must be viewed as more than a body of knowledge to be transferred to students. Curricular goals, in addition to the increased understanding of concepts and acquisition of knowledge, should focus on the development and application of skills to solve problems and the development of positive attitudes and values.

Content must entail more than lists of unrelated facts. Those involved in curriculum should reflect carefully upon how long-lasting understand-

Think of curriculum as what is formally taught, the actual experiences that are planned and provided to students.

ing is achieved. Thus, curriculum may be framed by process: how students learn and how teachers teach. This framework deals with the interactions of people and assumes that accurate recall of facts is a very limited indication of knowledge. Process should not imply teaching methods only, but rather a concern with how people learn.

Curriculum should be designed to ensure that students apply previously acquired knowledge, that students involve themselves in the learning process and that each year they assume more responsibility for their own learning.[4]

The Coalition of Essential Schools suggests redesigning the entire curriculum around thorough coverage of fewer areas as one way to ensure broad understanding, not just narrow or rote expertise. The Coalition's approach also emphasizes process, learning how to think and, especially learning how to use questions to explore problems.[5] Such questions should engage students in critical thinking throughout the curriculum.

Curriculum and Instruction

Discrepancies between the written curriculum and what is actually taught have been a long-standing cause for concern among educators.

Research provides us with an image of the teacher as an active curriculum maker. The teacher responds to numerous pressures and influences in making the day-to-day decisions about what is taught and how it will be taught. The written curriculum may be only one of several factors that the teacher considers.[6]

School boards and administrators may wonder how to respond to this situation. Attempts to develop stronger and more stringent controls over the teachers' influence on curriculum seem doomed to failure. Teachers working independently in their classrooms become a de facto curriculum, often highly resistant to external pressures to change. In addition, because overly tight systems of management and control can result in a loss of a teacher's flexibility and pride, these systems can interfere with effective teaching.

The best approach is a process to make the planned written curriculum and what is taught more congruent, but not completely overlapping.[7] The result is a teacher-supported curriculum. If teachers believe in the quality of the curriculum and have significant input in developing it, logically, they will be more likely to use and support it. This viewpoint presupposes an active role for teachers in the local curriculum development process.

Key Roles in Curriculum

Who decides what will be taught in our schools? The answer is complex and varies by school district. Generally, many groups and individuals exert some influence on curriculum.

The School Board

Various sections of state law detail the school board's legal responsibilities, which include prescribing courses of study and textbooks for the schools of the local district. The commissioner's regulations, in most instances, recommend but do not require the use of the state syllabi, so the exercise of initiative and responsibility on the part of local school authorities is promoted.[8]

Curriculum is one of the major factors that determines the quality of education, but studies have shown dissatisfaction among board members with the amount of time they devote to curriculum. One participant in a 1986 survey said, "We can't give up any area, but the board is overwhelmed; we go from crisis to crisis; we can't find time for planning, and we don't spend nearly enough time on curriculum, teaching and student learning."[9]

Board involvement may be further discouraged as the designs for reform presented in a number of reports include recommendations for change that depend upon school board leadership, and yet do not discuss the role of school boards.

Even within the framework of state-mandated programs, policies, syllabi and examinations, and within the time and scheduling constraints of board meetings and agendas, there is ample room for school boards to exercise initiative in curriculum. Because of its impact, boards should make curriculum a top priority.

In addition to deciding whether to approve changes in school offerings, a board can influence curriculum in many ways. Through its actions, the board sets the tone and provides direction for the district. Boards can be supportive of high standards, discuss curriculum often and in depth, and become familiar with course offerings and program changes.

The school board should develop and adopt a philosophy to guide curriculum and then use it as the basis for taking a survey of needs, as well as developing policy, goal statements and objectives derived from these goals. Simultaneously, the board, along with its staff, should seize the opportunity to examine its own purposes and priorities. To assist

with these tasks, sample policies are offered in the appendix. The New York State School Boards Association offers a variety of policy review and development services.

Budgets should clearly reflect the curriculum. Support should be provided for curriculum development and its implementation through the budget. Funds may be needed for release time to allow teachers to attend working sessions of curriculum committees, for professional literature, consultants, staff development and instructional materials.

By asking their superintendents for periodic reports, boards should make curriculum a regular item on their agendas. Boards should establish and support curriculum study and revision groups, as well as other appropriate mechanisms to involve interested constituencies. Finally, school boards should set the parameters for evaluating the instructional program.

As boards act in all areas of school governance, they would be wise to consider how each action will influence the effectiveness of the curriculum.

Others at the Local Level

The superintendent, building principals, other administrators and curriculum specialists should commit themselves to leadership in comprehensive curriculum planning and the related tasks of program evaluation, curriculum development, curriculum implementation and staff development. Each of these requires the attention of people knowledgeable in curriculum theory, design and practice, and those skilled in seeking curricular solutions to problems.[10] School boards need to look for these characteristics as they hire and evaluate administrative personnel.

Administrators, like school boards, may allow other matters to preoccupy them at the expense of curricular concerns. Boards, if they are diligent, can prevent this from happening.

Building principals in particular need to be knowledgeable about and involved in curriculum development if boards want them to be effective instructional leaders, not simply building managers (see the Association position paper *The Principalship*). As stated in the Commissioner's Regulations, Section 100.2(a):

> Within the policy guidelines of the board of education of the school

> district, and under the direction of the superintendent, each principal shall provide leadership in the development of the educational program in the school to which he or she is assigned, including the supervision and administration of the school program, involvement with the selection and retention of staff, professional consultation, direction and assistance to the faculty and students of the school, and fostering effective home/school/community partnerships.[11]

The role of building principals in these areas, particularly in curriculum development and implementation, will become a vital concern as districts consider moving toward school-based management philosophy and practice.

Much has been written in support of involving teachers in curriculum development. The reported benefits of their ownership of the curriculum are many. Involving teachers generates interest, enthusiasm and a better rapport among staff and administrators. Included in the rationale for increased teacher involvement is the idea that the closer the decision-making power is to the learner, the more finely tuned and responsive the system can be. As active players in the curriculum development process, teachers may be more likely to use and support the guides and materials they have helped to create.[12]

The issue of involving students in curriculum development should be approached from the point of view that the curriculum must be relevant to students if learning is to take place. Teachers must be sensitive to students' needs and the misconceptions they often bring with them to class. In other words, they must listen to students.[13] Curriculum should be written with a similar awareness and a knowledge of developmental considerations. Results of a 1987 national survey suggest very little student involvement in curriculum development.[14]

Parental involvement and support is necessary for the effective implementation of curriculum. Parents can become involved in many ways. Needs assessment surveys can be used to solicit their views. Committee representation can ensure their participation in the review and development process. At the very least, parents should know about and be encouraged to respond to proposed local program changes before they go into effect. The results of the survey reported in 1987 indicate a low average rate of parent participation despite broad support for their involvement.

Enthusiastic reports of success come from districts using community-based collaborative approaches to curriculum.[15] Community involvement, which often overlaps with parental involvement, should be supported. Members of the community may serve as resource persons who identify, for example, the skills necessary for successful employment within the community. An added benefit is the strengthening of school/community relationships.

Collaboration between schools and representatives of business, industry and institutions of higher learning result in efforts that have directly and indirectly influenced curriculum. These constituencies represent a vast resource for schools in terms of subject area expertise, internship and mentor experiences, equipment and materials, site visits and guest speakers, and—in many instances—funding for specific projects. Collaborative efforts have become increasingly common, but more are needed.

A collaborative approach to curriculum development involving all of these constituencies should effectively produce a rich curriculum and mutual trust and support for the instructional program. However, a board should not relinquish its authority to these parties. While being sensitive to what each group has to offer, the board in its leadership role should define clear expectations for the involvement of each group and for the use of the products of that involvement. Even groups deeply involved in curriculum, such as teachers and administrators, should operate within the board's framework of expectations.

The State Education Department

In New York State, the commissioner of education and Board of Regents, except in isolated and unrelated instances, have traditionally developed and set statewide curriculum requirements and recommendations.

The state Legislature plays a limited role in curriculum. Article 65, Section 3204(3) of the Education Law prescribes the subjects of study for public schools, but responsibility for changes in courses of study is given to the State Education Department. When curriculum mandates do come out of the legislature, they are rarely comprehensive in nature. These curriculum add-ons may specify that a particular topic, such as the dangers of drunk driving, be included in the curriculum at a particular level, such as high school.

Curriculum development at the state level, through the State Education Department, results in two types of materials: syllabi and supplementary materials or handbooks. A syllabus provides, often in outline form, a basic framework of objectives, concepts, understandings and skills. Supplementary materials offer a wide selection of learning activities that correspond to and extend the syllabus. The format of these materials varies from one publication to another.

A syllabus is intended to serve as a basis for local activities such as the development of local courses of study, adaptation of content to the needs of specific groups of children, selection and acquisition of support materials, and evaluation of student performance. Of course, the State Education Department also directly influences local curriculum through the state program of examinations.

The traditional approach to curriculum development at the state level commences when a syllabus and/or supplements, at a particular level for a particular subject or course offering, is designated for revision.

In New York State, districts have a great deal of freedom to develop an instructional program that meets the needs of their students.

Revising begins with needs assessment. Through the cooperation of classroom teachers, others from the education community, and the work of State Education Department subject matter bureau staff, new materials are developed and are pilot-tested, field-tested, and revised accordingly before their statewide implementation.

Although this approach to curriculum is basically sound, there may be weak areas and loose connections in need of strengthening. Key questions include whether the state emphasizes a subject-specific orientation or interdisciplinary, developmentally appropriate sequence of curriculum matter; whether students have opportunities to study fundamental principles in depth or is coverage of material emphasized; and whether the assessment of student progress reflects the goals of instruction.[16]

Many educators feel overburdened by state curriculum and testing requirements. The State Education Department should lead a broadly participative analysis of these critical issues, because state requirements and suggestions greatly influence the ability of local districts to plan developmentally sound, well-articulated programs.

It may be necessary for the State Education Department to lower its profile in curriculum and thereby allow more flexibility to local districts that wish to adopt creative approaches to the most appropriate instruction for their students.

School boards should be permitted, at least on a pilot basis, to have most regulatory constraints regarding staffing and programs removed if student performance is satisfactory. Then the schools can be redesigned to create new curriculum and instructional models. The Middle Schools Challenge Program illustrates a model for this broadened alternative.

Local districts share with the state much of the responsibility for curriculum development because state syllabi represent only a framework within which courses are to be developed. During local development, issues such as how to sequence content and course offerings and selection of instructional approaches should be addressed. Districts also should remain free to develop courses which are not based on the syllabus, although these should be submitted to the department for approval.

In New York State, districts have a great deal of freedom to develop an instructional program that meets the needs of their students. Local districts, guided by their school boards, are strongly urged to exercise this freedom. Unless they do, as many observers have pointed out, they may allow textbooks and standardized tests to become dominant forces of curricular control. Local leadership may default, with ineffective instruction the result.

Issues in Science and Mathematics Education

School boards should establish a direction for each content area. Through the development of philosophy and goals in the areas of science and mathematics, boards can establish priorities to guide the development of the instructional program and to establish important connections between subject areas and across grade levels.

Setting Priorities

When developing policy for science and mathematics education, school boards are faced with a basic choice. Which priority will guide the development of curricular goals: achieving a basic level of scientific and mathematical literacy for all students, or developing the scientific talent of those students who are likely to pursue higher education and careers in the sciences? Put more simply, who will be taught what?

Some educators believe that when too much emphasis is placed on the latter priority, science and mathematics become largely irrelevant and inaccessible to those students who represent the majority and who will not go on to study science and mathematics.[17]

The goal of science literacy for all students and the goal of preparing students for higher education and careers in the sciences must not be viewed as mutually exclusive. Both priorities should be incorporated into a well-designed curriculum.

Increasingly, knowledge of science and mathematics is recognized as vital for all students. The performance and interest of our students in these areas thus becomes a major cause for concern. Trends and predictions regarding the future of our society, its economy and demographic characteristics, suggest a serious impact on national and local interests. In the future, even entry-level jobs will likely require a high basic skill level and a familiarity with technological applications. Society will continue to grapple with issues and search for solutions to problems that are scientifically and technologically based, such as solid waste disposal. Will our students be able to meet these demands and challenges?

Advocates of scientific literacy for all students have recommended a number of changes in curriculum content, instructional methods and organizational structure aimed at increasing their interest and participation. Characteristic of this view are the beliefs that all children *can* learn science, mathematics and technology, and that efforts to this end should

begin early in each child's school experience and continue through high school.[18]

The following methods of making the science curriculum more effective should be considered:

- Introducing coherent substantive curriculum content into elementary school to provide a sound foundation for secondary school science
- Providing sufficient challenge and opportunities for involving students in learning science at the lower levels to maintain interest (and increase student enrollment) at the secondary level
- Reforming the secondary school curriculum so that courses, whether they are aimed at the science-able or designed for general scientific literacy, deal with a limited number of core topics in depth rather than presenting a smattering of many topics[19]

A strong foundation in science should serve the purposes of increasing science literacy for a wide range of students, preparing those students who will go on to more rigorous study, and raising the expectation that more than a few students will become seriously engaged in learning science.

A report by the National Center for Improving Science Education advocates "a hands-on, inquiry based science program in elementary school as the best possible preparation for all students, regardless of their circumstances. Hands-on science stimulates children's natural curiosity about science and thus encourages them to persist in the study of science."[20]

What Students Need to Know

Experts and educators disagree about science curriculum content. Science education has been traditionally discipline-based and oriented toward the acquisition of knowledge, and some continue to advocate this approach. But many others are convinced that the standard science and mathematics courses and textbooks have become obsolete.

Issues and problems that are technological in nature—such as global warming, pollution, nuclear energy and genetic engineering—dominate the world of today's students. The traditional academically geared courses may not help students deal with the countless ways their lives and planet are interconnected with the end product and practical application of science, which is technology. For science curriculum content to relate better to the student's world, it should focus on personal needs, societal issues and career awareness, as well as academic preparation.[21]

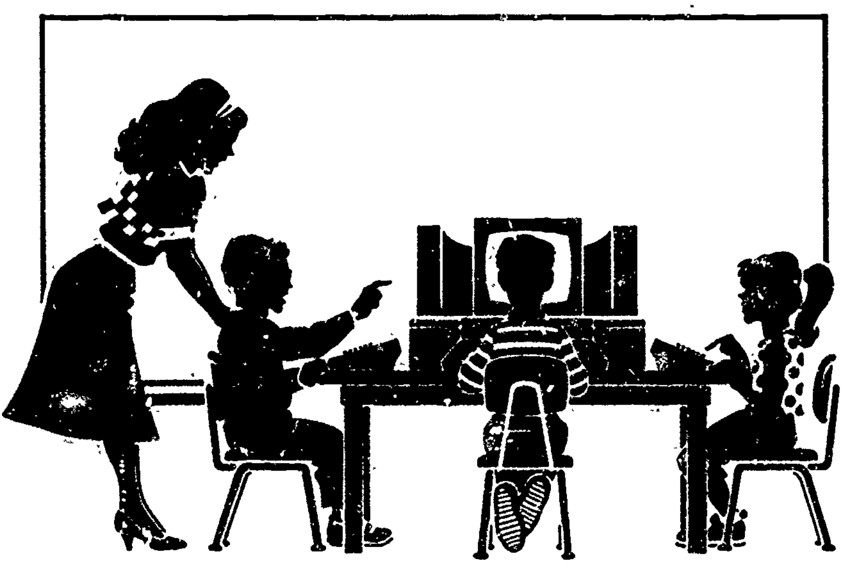
Models for this type of initiative already exist. The Science-Technology-Society (STS) project offers a framework for curriculum reform that emphasizes the interactions of science, technology and society. A similar framework is proposed for the elementary grades in a report of The National Center for Improving Science Education, *Science and Tech-*

nology Education for the Elementary Years: Frameworks for Curriculum and Instruction.

A different strategy, one that may be more adaptable to traditional science content, is suggested by the conceptual-change perspective. Its primary goal is to help students develop meaningful, conceptual understandings of science. Again, the emphasis is on the usefulness of the scientific knowledge encountered by students. In a conceptual-change approach, a central goal of science teaching is to help students confront and change their intuitive, everyday ways of explaining the world around them, and to incorporate scientific concepts and ways of thinking into their personal frameworks.[22]

In addition to changes in curriculum frameworks, science must indeed come to be viewed as basic to the general education of every student. To help this occur, science must be afforded the same amount of time and attention in the classroom that is now given to reading and mathematics.

Typically, a large portion of instructional time is devoted to mathematics, but mathematics subject area groups have recommended that mathematics curriculum and instruction shift emphasis. Although mastery of the basics of arithmetic should remain an important goal of schooling, decreased attention to complex arithmetic computation, rote practice and memorization would allow for increased attention to such topics as problem solving, probability and statistics. Basic skills in mathematics should be defined to encompass more than computational facility. Recommendations such as these have come in the wake of arguments from business leaders that emphasis on paper-and-pencil computation has failed to produce workers who think and solve problems in the workplace and who are able to continue to learn.[23]



Indeed, the change brought to mathematics by the advent of computer technology has increased the need for students to develop strong conceptual knowledge, while the need for extended skill in computation has diminished.[24] Overemphasis on procedural skills must give way to the critical thinking and problem-solving applications for which students must become well-practiced and knowledgeable.

Quantity and Quality

American students have done poorly on international assessments of science and mathematics, but those comparisons may not fully reflect the level of New York State's students.

At the secondary level, New York State schools use a state course of study with a state examination. Each Regents science course requires 1,200 minutes of laboratory experience before a student can sit for a Regents examination. For years, New York State students have excelled in receiving honors and awards in such programs as the Westinghouse Science Talent Search and National Merit Scholarships, as compared proportionally with the national student population.

The Regents Action Plan increased the science requirement for graduation to include a minimum of two units of science for both a local and a Regents diploma. The same is true for mathematics. Students must pass Regents Competency Tests in these subjects, except for those who pass Regents exams instead. The Regents Action Plan also added a one-unit requirement for technology, which must be completed by the end of grade 8.

New York has a "state-of-the-art"[25] elementary science syllabus that focuses on problem solving. Based on this, the first Elementary Science Program Evaluation Test was administered to fourth graders in May 1989 as a practical instrument to help districts assess how well their students are learning and to identify weak areas in their curriculum. This assessment included a manipulative skills test composed of five hands-on experiences.

As compared with other states, New York does a good job in science and mathematics education, but a number of questions arise.

One question concerns policies promulgated by the Regents Action Plan that have increased the number of courses necessary for high-school graduation. Of foremost concern is the effect this has on course-taking patterns: Is exposure to quality instruction really being increased? More research is needed to determine whether schools have opted simply to lengthen the amount of exposure without engaging the students in new content and competencies.

In New York State, fewer than half of our students are exposed to high-school-level coverage of chemistry and physics.[26] A national survey has indicated fourth graders spend an average of 28 minutes a day studying science, compared to 52 minutes studying math and 100 minutes

studying reading.[27] The New York State K-6 science syllabus recommends that five to ten percent of weekly time be spent on science instruction.

Opportunity to learn and time for instruction and student activities are critical to science learning at all levels. The typical K-6 curriculum minimizes the time available for science. Policy makers also need to be concerned with student assignment practices and the curriculum that is associated with ability groupings to the extent that the exposure of some groups to science and mathematics instruction is restricted.[28]

The teaching norm in many classrooms is oriented to textbooks. Widespread dependence on textbooks and lecturing presents a significant obstacle to reform. The most widely used textbooks superficially cover too many concepts, concentrate only on vocabulary and underplay hands-on instruction.[29]

School boards should recognize that textbooks are not and should not be the only instructional materials available. They should have textbook selection policies and provide in-service training as needed to help teachers learn how to use textbooks, workbooks, computer software, audiovisual and hands-on materials effectively (see the Association position paper *Textbook Selection: A Matter of Local Choice*).

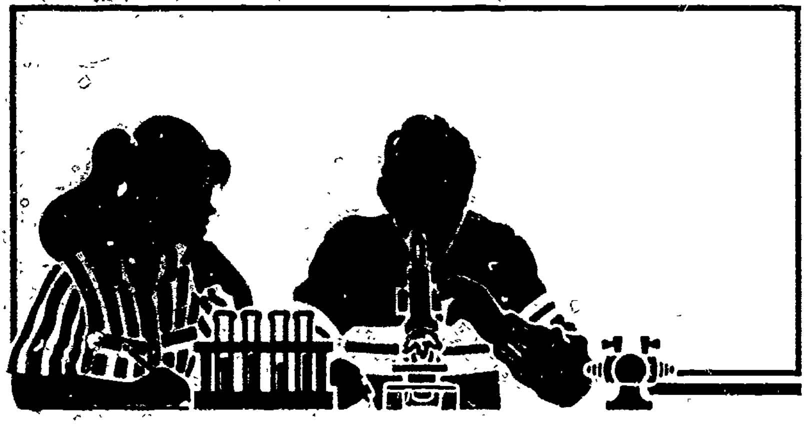
In New York State, even though syllabi, supplementary materials, and time recommendations are somewhat consistent with reform recommendations, it is questionable whether and to what extent these recommendations have actually taken hold in classrooms. Certain weak areas need to be looked at carefully. For example, the earth science syllabus and supplement and the general chemistry syllabus have not been revised since 1970, although they are currently under development. Syllabi and supplementary materials should be reviewed at least every few years.

Interdisciplinary/Integrative Approaches

The disciplines offer one way to organize thinking about the world, but dividing information into separate discipline areas may not be the best way of structuring a curriculum for students because of the isolation and fragmentation of knowledge that results from that practice. Interdisciplinary or integrative strategies and frameworks offer ways of improving science and mathematics curriculum.

Integrative curriculum is not a new idea. Thirty years ago it was defined as consisting of two parts. The first part provides learners with a unified view of commonly held knowledge; the second motivates and develops the learners' power to perceive and create new relationships for themselves. An integrative curriculum not only recognizes the interdependence of knowledge, it also recognizes its relevance to the life of the learner.[30]

An integrative curriculum may be organized in a variety of ways. If organized around subject area disciplines, it would be considered an interdisciplinary approach. Other organizers may include themes, concepts, great ideas or problems.



In practical terms, one way to better manage the vast spectrum of subject area content is to establish clear connections among the bodies of knowledge in various fields. Integrative approaches can be designed to allow for a more in-depth study of selected topics and issues from a variety of perspectives, and an application of skills to problems from other content areas.

Science and mathematics have long been closely related. Scientists utilize mathematics to analyze scientific problems and mathematics has often turned out to be crucial to the advancement of science. The science curriculum and the mathematics curriculum should help students become aware of this productive relationship.[31]

In a broader sense, linkages between science content and its societal, reasoning, historical or attitudinal implications may facilitate scientific literacy.[32] A focus on societal problems and issues may lead students into scientific investigations that cross over into and connect with social studies.

Leading middle-level educators have endorsed the use of interdisciplinary approaches. A recent report, *Turning Points*, suggests a core middle-grade curriculum organized around integrating themes that young people find relevant to their own lives. Mathematics and science could be combined in the study of themes such as, for example, mapping the environment. The life sciences could be clustered around themes relating to the developing adolescent.[33] Team teaching and cooperative learning can be used to support this approach.

A proposed State Education Department project that would identify common learner outcomes across subject areas from the syllabi for the middle grades would provide teachers with a valuable tool that would aid in planning and implementing interdisciplinary studies programs.

The move toward integrative approaches should not be hindered by concerns about teacher certification, which beyond the prekindergarten

to sixth-grade level is awarded by subject area. Instruction in methodologies that would allow all teachers to utilize integrative approaches should be incorporated into teacher-preparation programs. Substantial preparation and support will be needed for teachers and others charged with implementing integrative curriculum development.

Hands-on Instruction and Computer-based Learning

The educational environment of schools and classrooms profoundly affects the goals of curriculum. As is true for every subject, the environment of science and mathematics education should be appealing, vibrant and dynamic. To this end, the implementation of a problem-solving, inquiry-oriented curriculum requires the use of a variety of instructional approaches, and these require space and materials.

In science and mathematics, children at all levels of development can benefit from the use of manipulative materials to explore problems and deepen understanding. Hands-on work is particularly important at the elementary level, where the student's conceptual level requires tangible involvement.[34] Activities should be integrated with curricular goals such as the understanding of concepts and the demonstration and practice of specific skills, and not simply be add-ons to provide an occasional break from the regular routine.

In addition to hands-on materials, teachers need plenty of space, tables or desks with ample surface area, running water and electrical outlets. Teachers should also be prepared and encouraged to make the most of the resources available within the school and community, including the physical plant, surrounding grounds and human services.[35]

Hands-on work is particularly important at the elementary level, where the student's conceptual level requires tangible involvement.

Like hands-on instruction, the use of instructional media and computer-based technology must be integrated into the curriculum if it is to contribute effectively to student learning.

Computer-based instruction is underutilized in science and should be explored as an area with great potential for increasing learning outcomes. It is attractive for several reasons. Computers offer a capacity for presenting, simulating, and collecting and organizing data in the classroom that did not exist before their introduction. Computer tools facilitate and enhance science investigations. For example, students can use the computer to gather data with probes and sensors and then use the computer as a tool that can display that data in graphic form. Computer simulations allow students to conduct investigations that would otherwise be too dangerous or time-consuming (see the Association position paper *Instructional Technology: Policies and Plans*).

Case studies of exemplary programs support the idea that the use of computers to aid instruction leads to achievement gains. Enough is now known about effective instruction and student motivation to allow for the design of powerful computer-based learning environments and the critical review of existing computer-based materials.[36]

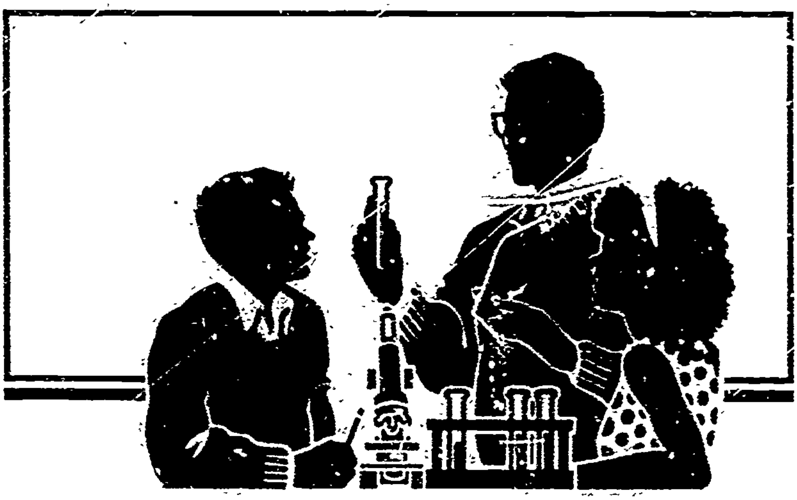
Program Sequence and Continuity

Local districts are and should continue to be afforded a degree of flexibility when sequencing content and course offerings in science and mathematics. The New York State elementary science syllabus, which concentrates on problem solving, is recommended for use. The design of the syllabus is such that those responsible for the local science program are not merely encouraged to thoughtfully establish and sequence the content of the program; the presentation of the syllabus makes it clear this is a critical, essential step toward local implementation.

The elementary mathematics syllabus, even though it is organized by grade level, affords the same degree of flexibility. According to its introduction, "teachers should use their own judgment concerning the order and presentation of topics."[37] The science curriculum for the middle grades is presented in blocks of related content so that local programs may be designed according to a variety of sequential patterns.

The New York State three-year course offerings in high-school mathematics exemplify a sequential design. A major goal is to spiral and sequence the topics included in the program throughout the three years so that the students review and build on previous learnings. A second objective is to integrate, when practical, branches of mathematics and mathematical topics.[38] Suggestions for integration of topics are provided in the syllabus. The mixed arrangement of the topics of algebra and geometry reflects a sound sequential and developmental organization.

Through its syllabi and supplementary materials, the state provides goals and suggestions for local program development, while the local



district, through its programs, should provide a more specific scope and sequence that the classroom teacher can use for instructional purposes. The content, skills, attitudes and values presented in the goals of the curriculum should also be articulated across the elementary, middle and secondary levels. That is, local program development and curriculum revision must always strive to achieve continuity and connection with what comes before and after each level.

Observers at the national level have raised concerns about the way science and mathematics typically are sequenced. According to William Aldridge, executive director of the National Science Teachers Association, the United States is the only country with a "layer cake" approach to science. In high school in the United States biology is taught one year, chemistry another year, and physics another.[39]

At the secondary level, science courses traditionally have been organized by discipline for a number of reasons, including a consideration of the advanced math tools needed for the study of chemistry and physics as these courses were designed.[40] Because these courses come toward the end of high school and only two science courses are required, many students are not exposed to high school level chemistry and physics. Depending upon the local sequence of course offerings, there may be a gap of several years between the time when students are introduced to topics in chemistry and physics, say in the eighth grade, and when they meet these topics again in their junior and senior years of high school.

One way to partially alleviate this problem is for middle and secondary school personnel to pay particular attention to reviewing and planning each student's sequence of courses. Student records and consultations with students can be used to develop programs that follow a logical sequence, meet the student's needs and offer sufficient challenge.

Back in elementary school the situation may be worse. When teachers assume that students must learn a lower order of information and skills before they can engage in higher-level problem solving, and when limited time is available for science, few students have the opportunity to solve science problems. Typically, teachers choose topics with which they feel comfortable, usually in the life sciences rather than the physical sciences. This is true even in the programs that stress hands-on activities. Often there appears to be no content recognized as essential, and the order of the content is deemed close to irrelevant.[41] In mathematics, similar factors combine and result in a heavy emphasis on computation at the expense of problem-solving skills and conceptual understanding.

Throughout the K-12 sequence it is unusual to link science and mathematics instruction, even though these two should be natural partners. Textbooks contribute to the fragmentation. Rarely do they use examples or methods from the other field. Science textbooks are often completely nonmathematical and nonquantitative.[42]

A combination of these factors may contribute to large gaps in the education of our students. The local curriculum-development process—relying on continuous needs assessment, program evaluation and staff development—clearly offers the best remedy for many of these curricular woes, but building a good science and mathematics program takes time and commitment on the part of school officials and staff. It cannot be said that there is one right model that school districts should always follow, but whatever methods are used, effective curriculum development is an ongoing process requiring long-range planning.

Related Concerns

The teaching and learning of science and mathematics are inextricably bound to a number of related concerns: the participation and achievement of female and minority students, the preparation and continuing education of teachers and the question of whether or not students would benefit from the institution of a national curriculum or national standards.

Women and Minorities in the Sciences

National statistics on academic achievement reveal substantial disparities among racial, ethnic, socioeconomic and gender groups. The most extreme disparities appear in science and mathematics. During the past two decades, women, and to some extent racial or ethnic minorities, have made important progress in narrowing these gaps. Even so, existing disparities are of increasing concern as a policy issue because, according to demographic projections, the youth cohort is decreasing and the poor and minorities will comprise a larger portion of it. At the same time, the demands for a better-educated work force and for more workers in science, engineering and computer specialties are increasing.[43]

The educational attainment of women, the poor and minorities in science and mathematics has an impact on the national economy and national security, and it reflects on education's responsibility for providing equal opportunity. Suggestions that many of these students lose interest in science and mathematics years before they reach high school are especially troubling.[44] Such problems are spawned by the very nature of the curriculum, instructional materials used in schools, and the images they present to students.

In New York State, one important indicator is the degree to which subgroups of students participate in Regents courses and Regents examinations. As indicated in the most recent issue of the annual report *New York: The State of Learning*, there is a relationship between the percentage of minority students attending schools and the percentage of students participating in Regents science and mathematics exams. In all public schools with no more than 20 percent minority enrollments, 42.1 percent of students participate in Regents mathematics and 34.9 percent of students participate in Regents science examinations. In all public schools with greater than 80 percent minority enrollments, there is a 17.0

Female students maintain a slightly higher participation rate in Regents mathematics and science examinations until the examinations that typically come at the end of course sequences.

percent participation rate for mathematics and a 9.1 percent participation rate for science.

Gender differences also exist. Female students maintain a slightly higher participation rate in Regents mathematics and science examinations until the examinations that typically come at the end of course sequences. In physics, the participation rate for males is 14 points higher than for females.[45]

School boards should address these concerns by examining indicators of access, participation and achievement within the local district, and by investigating programs and strategies that have been successful in increasing the participation and achievement of these groups in science and mathematics.

One solution may lie in the striking relationship between achievement in mathematics, science, technology and the early exposure of students to stimulating teaching and good learning habits in these fields, and enrichment by regular exposure to informal educational activities. Unfortunately, these experiences are frequently unavailable to minorities, those whose parents do not speak English at home and those who are economically disadvantaged. The skillful and early introduction of mathematics, science and technology in the elementary schools, therefore, is of paramount importance.[46]

Additional noteworthy recommendations include placement of science and mathematics specialists in elementary schools, and expanded counseling services to encourage more students to consider careers in these fields.[47]

Teacher Preparation and Development

School boards should encourage teachers to become effectively involved in curriculum development, to use a variety of instructional techniques such as inquiry-based and cooperative learning, hands-on approaches and computer-based instruction, and to send the right kinds

of messages to students about their ability to succeed and the value and usefulness of learning science and mathematics. This can happen only if teacher preparation and development are viewed as an integral component of curriculum support and development.

Teachers certified for grades Pre-K to six are likely to have limited preparation in the sciences and in the application of computers as tools for use in the classroom. One national survey reported that 82 percent of elementary school teachers considered themselves very well-qualified to teach reading, compared to 67 percent who considered themselves very well-qualified to teach math, 27 percent to teach life science and 15 percent to teach physical and earth/space science.[48] Topics from these areas are integral parts of elementary science.

The situation described may become somewhat improved in New York State with the implementation of new certification requirements that will require prospective elementary teachers to complete a concentration in one of the liberal arts and sciences, complete college-level work in science and mathematics, and complete a mentor-teacher internship.

Another concern is a reported shortage of well-qualified teachers. New York State is simply not producing enough teacher education graduates in such critical areas as mathematics and physics to meet the need. In 1989, fewer than 170 teachers statewide were awarded any form of certification that would allow them to teach high school physics.[49] Fewer certified physics teachers were actually available to fill vacancies, as many of this number already held positions and were simply upgrading their certification status. Others, it can be assumed, took jobs in business or industry. If school officials want not only to maintain programs, but to expand them to increase the exposure and participation of students to science and science topics, the availability of qualified teachers is absolutely necessary.

The best strategy for local districts in need of science and mathematics teachers is to recruit aggressively, and, to the extent allowed in New York State, consider recruiting candidates who have not taken the traditional route to the teaching profession.[50] At the elementary level, applicants for teaching positions should be interviewed with the science and mathematics programs in mind. One new recruiting alternative is the State Education Department's Teacher Recruitment Clearinghouse. Through it, candidates may submit their resumes and credentials, and school districts may publicize their vacancies. The clearinghouse ensures a reciprocal sharing of information by using appropriate software and the state's Technology Network Ties (TNT).

Staff development is a key to maximizing the effectiveness and contribution of each teacher. The central role of school boards in ensuring worthwhile staff development is exemplified by their goal-setting, policymaking and budget-approval functions. Although the actual implementation of staff development should be delegated to the superintendent

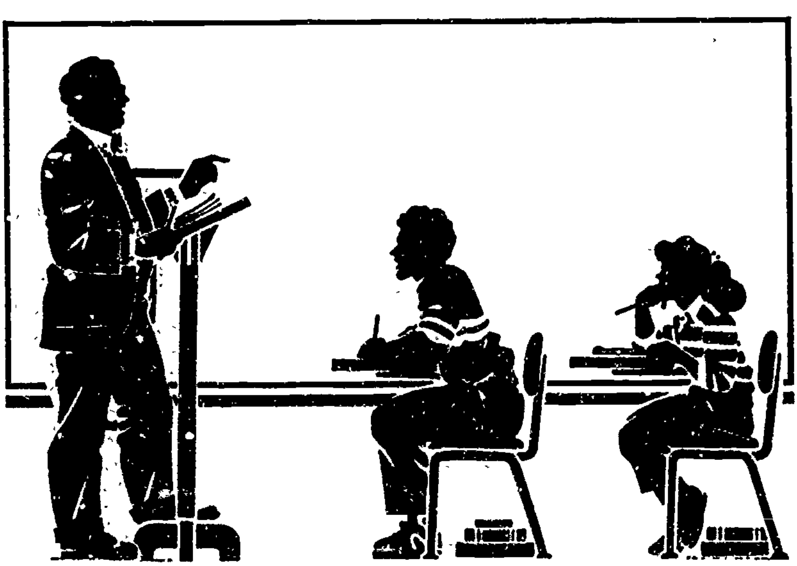
and administrative team, the board should continue to lead and monitor the process appropriately. Districts should address science and mathematics curricular and instructional issues in their in-service training programs, according to district goals and policies, and encourage teachers to attend professional meetings. Strategies that pair or group teachers so that they observe, share and learn from each other are encouraged (see the Association position paper *Staff Development: Catalyst for Change*).

Policies aimed at improving the instructional program may help those teachers who are highly skilled and those who are less skilled. One suggestion is that school boards encourage teachers to take science courses at local community colleges, and where possible, let the teachers use these courses for professional advancement instead of traditional graduate courses in pedagogy.[51] Partnerships between school districts and local institutions of higher learning would make modified versions of this type of initiative a very real and promising prospect.

The Question of a National Curriculum

Several events and trends seem to be pointing the United States in the direction of a national curriculum, or at least to a set of national standards. The limited selection and lack of variety among textbooks, the possible expansion of the National Assessment of Educational Progress (NAEP) to include state-by-state comparisons of students and the outlining of specific education goals by President Bush all contribute to this movement.

One of President Bush's six goals for education is to push Americans to the top of international comparisons of achievement in mathematics



and science.[52] Recent international comparisons have not reflected well on the proficiency of our students in science and mathematics. Typical of most foreign education systems is nationally centralized control of the schools, including curriculum. This centralized control facilitates adjusting the curriculum as needed in light of new developments in science and technology.[53]

Worried business, political and community leaders have concluded that America's continued leading status in science and technology is too important an issue to be left to state legislatures, departments of education and local communities. Public opinion, as reported in the annual Phi Delta Ka ~/Gallup Poll of 1989, shows strong support for a national public school curriculum, national goals and standards, and a national testing program.[54]

Historically, however, states and localities have cherished their constitutionally protected right to determine the content of schooling. School boards and others have expressed the belief that a comprehensive national curriculum is likely to be too inflexible to adapt to local needs and concerns. In commenting on his goals for education, President Bush seemed to voice agreement when he stated, "We have our principles set, but I believe the emphasis must be at the state and local level." He also noted, "We can exhort, but I don't think we can dictate to the school level."[55]

School boards may nevertheless be compelled to consider whether national standards or goals would be desirable to the extent that they offer the potential to force improvement in some areas of the country and provide some consistency of purpose. But will a set of standards go beyond minimum criteria for student performance? Uniform minimum standards pose the danger of institutionalizing complacency and mediocrity. How will this concern be addressed?

Several questions should be explored and investigated carefully before any federal initiatives are endorsed. These include: Who would develop national standards? What would they encompass? What process would be used to reach consensus on the standards? What would be the relationship between national and state and local standards? How would implementing and evaluating the national standards be controlled? How would the roles of those involved in curriculum at the local level be affected?

Conclusion

Public schools will continue to be at the center of discussions that are focused on improving curriculum to better serve national, regional and local interests, as well as the personal interests of our students as they prepare for adult life. School boards must strive to become well-informed decision-making bodies that provide for the kinds of structures and support that lead to excellence and equity. The key questions presented here should help to provide guidance to school boards during the major phases of the curriculum development process.

1. When the school system is developing a new curriculum
   - Who determines priorities?
   - Who develops the timeline?
   - Who assigns members to curriculum committees?
   - Who coordinates the efforts of curriculum committees?
   - Who devises the curriculum development process?

2. After the curriculum has been approved and it's time to put it into place
   - Who decides on the materials and activities for the new curriculum?
   - Who determines how much money will be needed to carry it out?
   - Who decides what staff development will be offered to prepare teachers to use it?

3. Finally, when you're looking at whether or not a curriculum is living up to expectations
   - Who decides how the curriculum will be evaluated?
   - Who is responsible for carrying out the evaluation?
   - Who is responsible for reporting the results of the evaluation to teachers, administrators, school board members, and the public?[56]

By answering these questions, boards will know who plays what role in the curriculum-development process and who is accountable. The questions listed above can help school boards exercise responsibility as they oversee curriculum. The final set in particular should be asked continuously, regardless of whether any new initiatives are underway.

No listing of concerns or examination of issues can provide completely adequate curricular guidance to school boards. Each content area has

its own history of traditional metho ologies and newer innovative approaches. It would be impossible for board members, and for most people, to attempt to be experts in every field; indeed, that should not be viewed as necessary.

A primary mission of school boards is to exercise responsibility and ongoing leadership for curriculum. Overseeing the curriculum is a crucial feature of serving the needs and interests of children, youth and their communities.

Appendix

Sample Policies

LAMPS Sample Policy 4200

Curriculum Development

In order to achieve its annual instructional goals, the Board of Education supports a collaborative approach to district curriculum development. Such an approach must recognize the interrelation of a "core" curriculum and effective instructional processes as well as interdisciplinary applications and articulation of programs from one level to the next.

A core curriculum will include basic content area knowledge and related skills, while recognizing that such information needs continual updating. Curricula will also be designed to encourage transferrable concepts/skills, including critical thinking skills. The Board is committed to providing district students and staff with appropriate instructional materials to implement curricula. In addition, all students are assured equal access to courses of study, consistent with federal and state law.

The Superintendent of Schools shall work with other district administrators to integrate current educational theory and research on curricula design, and successful instructional strategies practiced by comparable districts. Teachers and program directors are directed to use state syllabi, supplemental materials and handbooks for general curricular guidelines; however, the Board encourages instructional staff to create individualized, flexible curriculum guides and original instructional materials. Such materials shall reflect a sensitivity to district students, their concerns, learning styles, and changing developmental abilities/needs.

Parents and members of the community are also encouraged to provide feedback on district curricula and instruction. The Superintendent will consult with Building Principals, teachers, students and the community in order to develop a responsive curriculum, and to promote a continuing review and upgrading of such curriculum. To this end, the Superintendent shall periodically invite community input using a curricula-assessment questionnaire or other means. This information, along with input from citizens' advisory committees, will be utilized annually in evaluating and revising district curricula.

Curriculum changes will take into consideration the results of state and local testing/classroom evaluations, reflect minimum state requirements and address further needs of the community and student population. The Board expects administrators and instructional staff to work together in evaluating the educational program and recommending changes or additions in courses, programs, instructional methodology and/or staff development activities that are necessary to implement such changes and/or additions.

At its meetings, the Board will hear regular reports on curriculum-related matters such as instructional programs, the work of curriculum committees and periodic evaluation of specific curriculum areas. The Superintendent will also be responsible for implementing curriculum studies, including pilot projects, as authorized by the Board.

Cross-ref: 1210, Citizens' Advisory Committees
4000, Instructional Goals
4220, Pilot Projects
4310, Basic Instructional Program
4510, Instructional Materials
4532, School Volunteers
5020, Equal Educational Opportunities
9280, Professional Staff Development

Ref: Education Law §801 et seq.; 1709(3); 1711(5); 2503(4); 2508; 2554(11); 2566(4); 2590-g(l)(h)(8)
8 NYCRR §100 et seq.

Note: This policy was developed by the Office of Policy and Risk Management Services of the New York State School Boards Association. For more information, contact the Policy and Risk Management Services Department at (518) 465-3474 or 1-800-342-3360.

Science and Mathematics Instruction

The Board of Education believes that instruction in science and math ematics is crucial for student success in today's rapidly changing and competitive world, which increasingly demands higher levels of scientific and mathematical skills, as well as experience in technological applications. The Board therefore supports an interdisciplinary instructional program that encourages and expects basic literacy in science and mathematics, and prepares interested students for further study and/or careers in these fields.

Basic literacy in science and mathematics includes instruction in a "core" body of information but also emphasizes problem-solving and critical-inquiry processes. Students shall be encouraged to apply such skills to contemporary concerns and problems facing the school and the community in a "hands-on" learning environment (i.e., recycling projects, energy conservation projects, etc.).

The Board directs the Superintendent of Schools to oversee the development of a flexible science and mathematics curriculum, which takes into consideration new developments in all related fields and emphasizes the world's changing needs. Such curriculum shall include the following:

1. basic knowledge and skills in science and mathematics, and the opportunity to develop such skills and apply them to societal and individual problems
2. opportunities and encouragement for all students to participate in appropriately challenging courses of study
3. opportunities for students to develop an understanding of and appreciation for the relationships among science, mathematics and technology through interdisciplinary study
4. opportunities for students to develop a positive attitude towards science and mathematics and a spirit of inquiry towards the natural world
5. information on career opportunities in science and mathematics
6. opportunities for students to develop confidence in their ability to apply and develop scientific/mathematic knowledge and skills
7. individual and group problem-solving experiences and enrichment activities
8. student participation in a variety of experiences and course-related materials, including field trips, laboratory and classroom experiments, and use of computer-based technology

9. evaluation of student progress in assimilating and applying scientific/mathematical knowledge and skills, and periodic feedback to students regarding such progress

The Superintendent shall inform the Board of all curricular changes and advise the Board of necessary and up-to-date instructional materials to properly implement such curriculum. The curriculum should be designed to properly prepare all students for their role in society and ensure district compliance with the curricular requirements of the State Education Department.

Cross-ref: 4200, Curriculum Development
4310, Basic Instructional Program
4510, Instructional Materials
4510.1, Instructional Technology
4526, Computer-Assisted Instruction

Ref: 8 NYCRR §100.2-100.5

Note: This policy was developed by the Office of Policy and Risk Management Services of the New York State School Boards Association. For more information, contact the Policy and Risk Management Services Department at (518) 465-3474 or 1-800-342-3360.

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Glossary*

Articulation. The degree of connection and continuity provided by the curriculum across grade levels and between buildings in a school system. An example of a key question is: How well is the elementary school curriculum preparing students for the middle grades and secondary grades?

Congruence. The degree of correspondence or alignment between the curriculum as presented in syllabi and guides, the content of what is taught and the testing program. It is also used to refer to the level of coordination between programs such as compensatory and regular classroom programs.

Course Approvals. A locally developed course of study that is not based on the state syllabus must be approved by the State Education Department. The district must provide the department with a detailed course of study, lists of books and materials to be used and other information in order to be approved.

Curriculum. The actual experiences provided to students, what is formally taught based upon syllabi and guides, textbooks and other materials.

Curriculum Development. The entire process of improving instruction in any field or aspect of the educational program. Curriculum development usually results in the production of curriculum materials or instructional supplements. Curriculum development includes needs assessment, planning, research, writing, reviewing and editing, field testing, implementation and evaluation.

Curriculum Evaluation. Techniques and procedures used to evaluate the effectiveness of the curriculum in terms of progress toward satisfying planned objectives. These may include standardized or locally developed tests, questionnaires, observations, portfolios of student work or case studies.

Curriculum Guides. Documents that usually provide objectives and descriptions of curriculum content, sequence, sample lesson plans and advice on selection of methods and materials. These are often locally or commercially developed for a particular course of study or grade level(s).

Curriculum Implementation. The phase of the curriculum-development process during which the curriculum materials are field-tested, refined and edited, and, based on user feedback, published and disseminated. Attention is also given to staff development and initial monitoring as new materials are provided for classroom use.

Instructional Program. Used interchangeably with the word curriculum and may be used to refer to the specific philosophy, materials and instructional practices adopted by a school or district.

Integrative Curriculum. An approach to curriculum design not based upon the separation of subject areas but built around organizers such as topics, ideas, themes or problems. Integrative curriculum seeks to unify a student's educational activities across subject area boundaries. An interdisciplinary approach is one that attempts to establish clear connections between subject areas.

Mandates. The minimum program that all schools in the state must offer, as described in the Education Law, the Regulations of the Commissioner of Education and the Rules of the Board of Regents.

Needs Assessment. The process of defining needs in order to set the stage for curriculum development and guide curriculum planners in identifying learning experiences that should be changed or improved. It serves as a method for involving staff, students, parents, and the general community in setting goals and priorities for the schools.

Need is defined as the difference between the ideal and the actual. An assessment of needs should be made to determine the discrepancy between the desired goals and the actual conditions of education in district schools.

Scope and Sequence. Usually an outline or chart of curriculum units or topics that tells or suggests a grade-by-grade order for and the degree of coverage of required topics and optional topics. May include suggested amounts of time to be devoted to each unit or topic.

Supplementary Materials. Handbooks that supplement the syllabi. These offer a wide selection of learning activities for students of varying needs, interests and abilities.

Syllabi. Documents developed by the State Education Department in cooperation with teachers and consultants that provide, often in outline form, a basic framework of objectives, concepts, understandings and skills. Syllabi are used by school districts to implement the study of required and other subjects.

*Many of these definitions are derived from the New York State Education Department publication, *Curriculum Development. A Handbook for School Districts* (Albany, N.Y.: 1982).

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